REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

(1)

1. Agency Use Only *(Leave blank)*.

2. Report Date.
1990

3. Report Type and Dates Covered.
Proceedings

4. Title and Subtitle.

Plans for the Kuroshio Extension Regional Experiment (KERE)

5. Funding Numbers.

Program Element No. 61153N
Project No. 03208
Task No. 080
Accession No. DN394458

6. Author(s).

Jim L. Mitchell

7. Performing Organization Name(s) and Address(es).

Naval Oceanographic and Atmospheric Research Laboratory
Ocean Sciences Directorate
Stennis Space Center, MS 39529-5004

8. Performing Organization Report Number.

PR 90:062:321

9. Sponsoring/Monitoring Agency Name(s) and Address(es).

Naval Oceanographic and Atmospheric Research Laboratory
Ocean Sciences Directorate
Stennis Space Center, MS 39425-5004

10. Sponsoring/Monitoring Agency Report Number.

PR 90:062:321

11. Supplementary Notes.

PACON 90

12a. Distribution/Availability Statement.

Approved for public release; distribution is unlimited.

12b. Distribution Code.

13. Abstract *(Maximum 200 words)*.

During the mid-1990's the Kuroshio Extension Regional Experiment (KERE) will examine the critical issues governing the dynamics and energetics of the Kuroshio Extension Current System. Specific scientific issues to be addressed are: (a) the presence (?) and impact of a Deep Western Boundary Current (DWBC) on the Kuroshio Extension, (b) the ratio of internal (gravest baroclinic) mode to barotropic mode and its effect on Kuroshio Extension mesoscale dynamics (particularly in the Oyashio Intrusion area), (c) the relationship between surface wind stress forcing and gyre circulation of the NW Pacific. Additionally, the impact on Kuroshio separation and eastward penetration by geometric forcing from coastlines and bathymetry will be studied. Focused on these issues will be several major new technologies (as most recently demonstrated during the NW Atlantic Regional Energetics Experiment (REX)). These will include: (a) satellite altimetry (from TOPEX/Poseidon, ESA's ERS-1, and the U.S. Navy's SALT satellite), (b) satellite scatterometry (from ESA's ERS-1), (c) satellite infrared imagery (IR), (d) numerical model experiments, (e) a complimentary field program.

14. Subject Terms.
(U) Altimetry; (U) Mesoscale Oceanography; (U) Ocean Forecasting

15. Number of Pages.
3

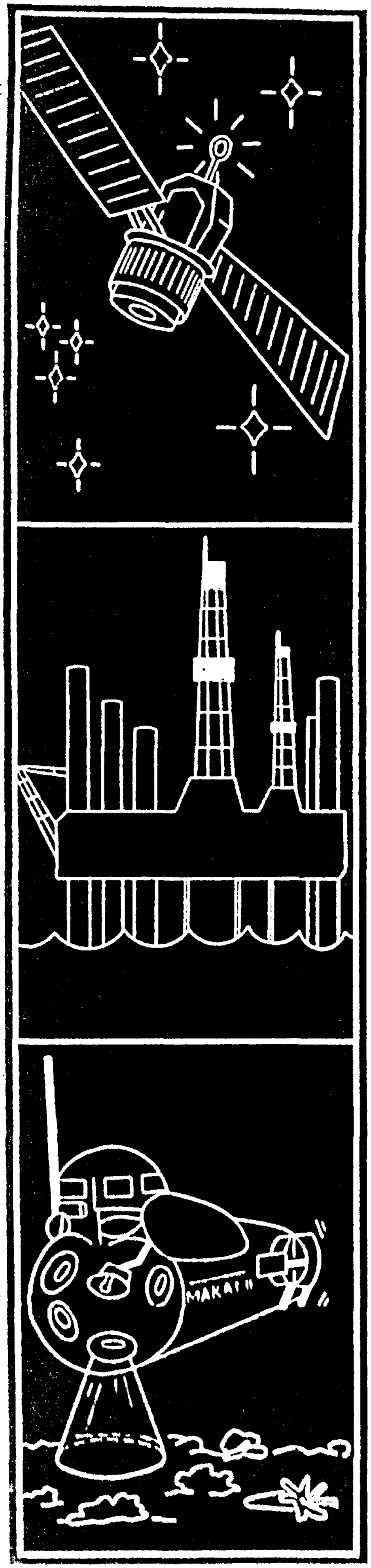
16. Price Code.

17. Security Classification of Report.	18. Security Classification of This Page.	19. Security Classification of Abstract.	20. Limitation of Abstract.
Unclassified	Unclassified	Unclassified	SAR

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. Z39-18
298-102

91 2 11 181



Proceedings of the

FOURTH PACIFIC CONGRESS ON MARINE SCIENCE AND TECHNOLOGY

VOLUME I

PACON 90

TOKYO, JAPAN JULY 16-20, 1990

PLANS FOR THE KUROSHIO EXTENSION REGIONAL EXPERIMENT (KERE)

Jim L. Mitchell

Naval Oceanographic & Atmospheric Research Laboratory Sensing Space Center, MS 39529 U.S.A.

Abstract

During the mid-1990's, the Kuroshio Extension Regional Experiment (KERE) will examine the critical issues governing the dynamics and energetics of the Kuroshio Extension Current System. Specific scientific issues to be addressed are:

(a) the presence (?) and impact of a Deep Western Boundary Current (DWBC) on the Kuroshio Extension,

(b) the ratio of internal (gravest baroclinic) mode to barotropic mode and its effect on Kuroshio Extension mesoscale dynamics (particularly in the Oyashio Intrusion area),

(c) the relationship between surface wind stress forcing and gyre circulation of the NW Pacific.

Additionally, the impact on Kuroshio separation and eastward penetration by geometric forcing from coastlines and bathymetry will be studied.

Focussed on these issues will be several major new technologies (as most recently demonstrated during the NW Atlantic Regional Energetics Experiment (REX)). These will include:

(a) satellite altimetry (from TOPEX/Poseidon, ESA's ERS-1, and the U.S. Navy's SALT satellite),

(b) satellite scatterometry (from ESA's ERS-1),

(c) satellite infrared imagery (IR),

(d) numerical model experiments,

(e) a complimentary field program.

Introduction

The KERE represents a coordinated project involving the major techniques of remote sensing, field experiment, and ocean numerical modeling as depicted in Figure 1.

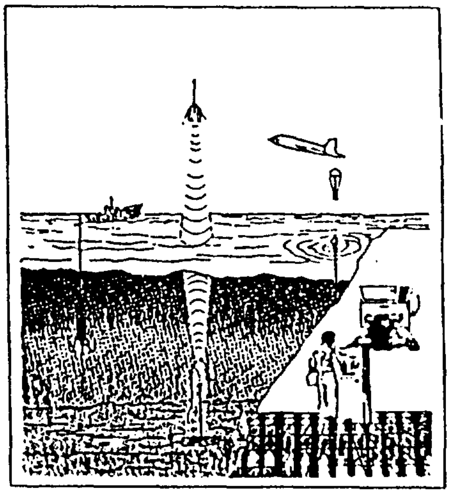


Figure 1-- Artist's concept of major components of the Kuroshio Extension Regional Experiment.

Key data types supporting the KERE are satellite altimetry and scatterometry from SALT, TOPEX/Poseidon, and the European ERS-1. In situ data will come from Inverted Echo Sounders with bottom Pressure Gauges (IES/PGs), current meters, and AXBT/XBT surveys. Data synthesis and analysis will proceed through the use of regional, eddy-resolving numerical models of the ocean circulation.Field experiment design will be largely motivated by (and its strategy planned) using numerical model simulations. Efficient and complementary field measurements will be emphasized. The vast quantities of altimeter-measured sea surface topography available from the altimetric satellites will allow

improved analyses using model-data assimilation schemes. Scatterometer-derived winds from ERS-1 will allow a detailed examination of the role of surface wind forcing in modulating a western boundary current, particularly over the larger North Pacific Basin (where the wind stress curl may play an even more dominant role than in the smaller North Atlantic). Analysis of these satellite data will proceed in both the Kuroshio Extension and Gulf Stream systems, while the collection of in situ data during the KERE will take place in the Kuroshio Extension only.

NW Atlantic Regional Energetics Experiment (REX)

The KERE is designed as a follow-on experiment to the presently concluding NW Atlantic Regional Energetics Experiment (REX). Some of the most notable preliminary REX results include:

(1) Consistent sea level variability amplitudes are observed from GEOSAT altimetry (see Figure 2), IES/PG arrays, and model simulations incorporating a Deep Western Boundary Current;

YEAR 2 SURFACE VARIABILITY

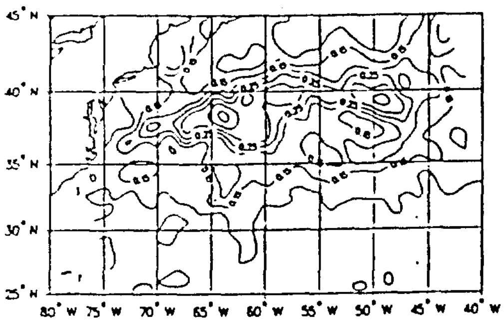


Figure 2-- Sea level variability (RMS in cm) of the NW Atlantic Gulf Stream region as observed during 1988 with GEOSAT-ERM altimetry.

(2) GEOSAT-ERM analysis indicates two-gyre structure in the recirculation south of the Gulf Stream (see Figure 3);

ANNUAL MEAN SURFACE TOPOGRAPHY YEAR 2

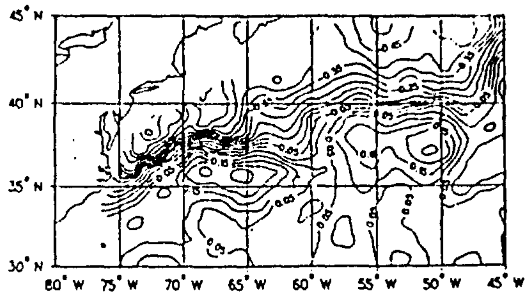


Figure 3-- Annual mean sea surface topography (cm) as observed during 1988 with GEOSAT-ERM altimetry. Note the prominence of two local recirculation gyres south of the Gulf Stream.

(3) Barotropic mode accounts for 1/3 of mesoscale RMS variability in sea level of the Gulf Stream;

(4) Precise alongtrack geoid profiles (computed from collinear altimetry and complementary AXBT sections) and/or IR images allow for the first detailed maps of both the mean and variable topography over the NW Atlantic (see Figures 2 and 3);

(5) Climatology-based regressions can be used to generate highly realistic "synthetic" thermal, salinity, and sound speed sections from collinear altimetry over the NW Atlantic.

Through the comparative effort mounted in KERE, some general conclusions regarding the basic nature of western boundary currents will be possible. KERE, in combination with REX, will represent a thorough study in the comparative anatomy of western boundary currents.

Satellite Analysis Plans for KERE

As already noted, a major component of the KERE will be the analysis of satellite altimetry, IR, and scatterometry in both the NW Pacific and NW Atlantic. Analyses of both the mean and variable surface topography (such as those depicted for the NW Atlantic in Figures 2 and 3) from satellite altimetry will play a major role in the KERE. Such analyses are useful for:

(a) Examing the impact of bathymetry on the western boundary current (for example, the two gyre recirculation structure seen in Figure 3 is clearly associated with the presence of the New England Seamount Chain (NESC) in the NW Atlantic),

(b) Tuning and adjusting numerical model simulations to obtain results in agreement with the altimetry (e.g., this is the way in which the importance of a DWBC in the NW Atlantic was first recognized during the REX; see Thompson and Schmitz, 1989),

(c) Studying the regional distributions of both eddy and mean kinetic and available potential energies (for example, see Figures 4 and 5).

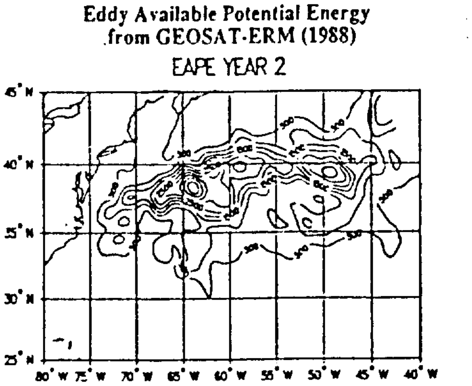


Figure 4-- Eddy Available Potential Energy (EAPE in cm²/sec²) of the Gulf Stream computed from surface topographic RMS observed with GEOSAT-ERM altimetry. Distribution and magnitudes depicted are in excellent agreement with other estimates of EAPE based upon in situ hydrography.

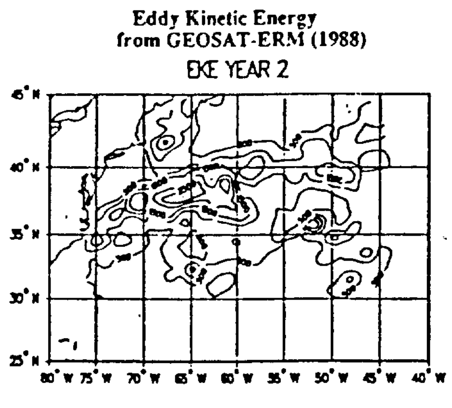


Figure 5-- Eddy Kinetic Energy (EKE in cm²/sec²) of the Gulf Stream computed from surface topographic RMS observed with GEOSAT-ERM altimetry. Distribution and magnitudes depicted agree well with other estimates of EKE based upon drifter data.

We will continue altimetric analyses of the NW Atlantic and extend these analyses to the NW Pacific during the KERE. Additionally, the statistics of mesoscale variability derived from satellite IR will play an important role in the KERE. Finally, surface wind stress fields observed by ESA's ERS-1 will provide important (and, long-awaited) input for the ocean circulation models.

Numerical Model Experiments in KERE

Work is already underway at the U.S. Naval Oceanographic & Atmospheric Research Laboratory (NOARL) on the development of realistic primitive equation (PE), layered models of the North Pacific Basin (including the Kuroshio and Kuroshio Extension). Use of these layered PE models has been demonstrated to have remarkable success in simulating and in providing meaningful forecasts of Gulf Stream evolution (see paper by Fox, Carnes, and Mitchell in this session). Using realistic bathymetry and coastline geometry, our 1/4°-resolution PE models are now able to successfully simulate many salient features of the North Pacific, including the Subartic Front and the Kuroshio Extension (see Figure 6). Comparison between model simulations (such as surface topographic variability shown in Figure 7), satellite analyses, and field data will serve as the basis for model improvements.

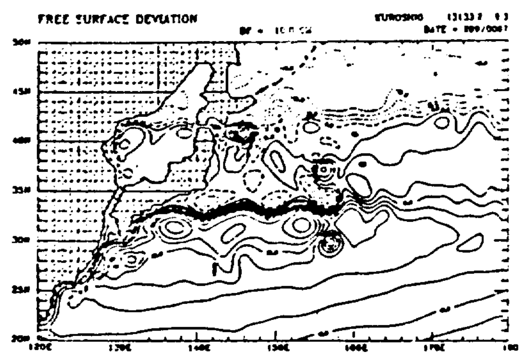


Figure 6-- A synoptic view of the Kuroshio Extension region from numerical model simulation. Contours represent sea surface topography (courtesy of Dr. H. Hurlburt, NOARL).